

NETWORK & MISSION
SERVICES PROJECT

CODE 450

NASA SN SUPPORT FOR RANGE SAFETY
CONCEPT AND FEASIBILITY STUDY
STATUS REPORT



NASA SN Support for
Range Safety
Concept and Feasibility Study
Status Report

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AGENDA

- BRIEF HISTORY OF EVENTS
- THE SN SUPPORT FOR RANGE SAFETY
CONCEPT AND FEASIBILITY STUDY
- CURRENT STATUS
- POINTS OF CONTACT
- WHERE TO FROM HERE
- CONCLUSION



BRIEF HISTORY OF EVENTS

- In 1997 the Lockheed Martin Team was directed by GSFC Management to perform an independent analysis of the Feasibility of SN/TDRSS Support for Range Safety
 - Spearheaded a Concept/Feasibility Study, evaluated both Technical and Operational Aspects
 - Represented GSFC Network and Mission Services at Several Range Related Forums (RCC, Space Congress) and Established Numerous Contacts
 - Fostered/Provided Input to Several Similar Study Activities (i.e., Range Standardizations and Automation - RSA, Eastern Range - ER)
- The Concept has been Well Received and we are Now at a Decision Point as to How to Proceed
- This Effort has been very timely in that it coincides with parallel Range studies and Matches the Demands & Strategic Plans of the USAF



BRIEF HISTORY OF EVENTS

- Key Events (June 1996 - December 1997)
 - Second TDRSS Workshop/Range Safety Splinter Group (6/96)
 - NASA HQ Meeting (7/96)
 - Wallops Range Commanders Council/Range Safety Group (10/96 - Turning Point)
 - Eastern Range (ER) USAF Letter Recommending to Examine TDRSS for Range Safety (1/97 - Key Support from USAF)
 - Preliminary Business Case provided to Code 450 (3/97)
 - Code 450 Presentation to SOMO (4/97)
 - Nellis AFB Range Commanders Council/Range Safety Group (3/97 - Associate RCC/RSG Members)
 - Telecon with USSPACECOM Kick-Off for Investigating Space-Based Platforms (5/97)
 - Development of Draft GSFC Concept/Feasibility Study (5/97 - Initiated; 1/98 - Limited Distribution; Well Received/Reference in Subsequent Analyses)



BRIEF HISTORY OF EVENTS

- Products
 - Presentations - RCC/RSG, GSFC Network Management, SOMO (10/96, 1/97, 3/97, 4/97)
 - Tactical Guidelines Document (12/96)
 - Preliminary Business Case (3/97)
 - **SN Support for Range Safety Concept and Feasibility Study (12/97)***
 - **Whitepaper: SN Support for Range Safety Concept and Feasibility (5/98)***
- Range Community Feedback on ALL ASPECTS of this Activity are **EXTREMELY POSITIVE** (as opposed to when this effort was initiated)

* Item covered in Detail on Following Pages



SN SUPPORT FOR RANGE SAFETY CONCEPT AND FEASIBILITY STUDY

- Initiated in May 1997
- Four Iterations
 - October 1997: Preliminary
 - November 1997: First Draft
 - December 1997: Preliminary Work Draft
 - » Circulated in a Limited Distribution
 - » Received Positive Feedback
 - » Emerged as a Reference Document for DOD Presentations, Studies, and Analyses
 - April 1998: Working Draft
 - » Verified and Incorporated All Comments Received
- Next Version will be the BASELINE DOCUMENT (Early June) for Wider Distribution



SN SUPPORT FOR RANGE SAFETY CONCEPT AND FEASIBILITY STUDY

- The Study Conclusion at this time indicates that the Concept is Technically and Operationally Feasible to Support the ER and WR Command Destruct System (CDS) with the Space Network
- Operational Scenarios
 - Transition from UHF System to S-Band System (Ground and Launch Vehicle)
 - Eliminate Down Range Stations and provide Continuous Coverage through All Launch Phases
 - SN/TDRSS Role Primarily to Supplement the Launch Head with S-Band Down Range Support - “Seamless” Transition
 - Launch Head and TDRSS Radiate PN Spread Signals
 - » RS Receiver track both signals



SN SUPPORT FOR RANGE SAFETY CONCEPT AND FEASIBILITY STUDY

- Is a standard TDRSS signal, non-spread, or GN Mode more advantageous?
 - Link Margins
 - Acquisition Time
- Assessed Areas that May Require Refinement
 - Link Margin. Static CLASS Analysis Forward Link - 18.8 dB
 - Data Latency. ~350ms (terrestrial thru GSFC)
 - Data Security. Diverse routing, encrypted at ROCC
 - RFI (Anti-Jamming). PN Spread Signal
 - LV Equipment. Multi-channel S-Band Receiver, Antenna Positioning
 - TDRSS Shuttle Hi Power. Waiver from NTIA required
 - Cost. Estimates imply significant cost savings (Millions of Dollars). Operations and Maintenance reductions.



SN SUPPORT FOR RANGE SAFETY CONCEPT AND FEASIBILITY STUDY

- Several Technical Challenges have been Identified and Need Further Investigation
 - Verify TDRSS telemetry Identical to Ground Station Telemetry.
 - Measured Actual Data Latency is less than 500 milliseconds
 - Mitigating Multipathing from Liftoff through First Stage Flight
 - TDRSS has no Experience with the LV Command Destruct
 - S-Band LV Range Safety Command Destruct Equipment
 - NTIA Waiver for Exceeding PFD Limitations
 - Potential for WSC Modulator Doppler Predictor (MDP) to provide non-spread PM on a sub-carrier
 - Are There More?



SN SUPPORT FOR RANGE SAFETY CONCEPT AND FEASIBILITY STUDY

- The SN Support for Range Safety Whitepaper was Derived from the SN Support for Range Safety Concept and Feasibility Study (12/97)
 - High Level Overview of the Contents of the Study
 - Prepared for Purposes Professional Organization Presentation (i.e., AIAA, Space Congress, Range Commanders Council)



CURRENT STATUS

- Most Recent Events

- Letter from Vice Commander USSPACECOM, General Estes, to USAF Chief of Staff, General Ryan, at the Pentagon stating -

“To complete our (USAF) vision, we’ll need a space-based communications network and a command destruct system that employs this network.”

- 35th Space Congress (Whitepapers Presented)

- » **Command and Control Through Space-Based Systems (Chris Bocchino)**

The GEO satellites appears to offer the best solution. The GEO satellites may only require a single hand-off or none at all and they are usually configured to handle doppler shifts such as TDRSS. Even though GEO satellites can cover the launch location and in-flight coverage, a command ground station combined with the GEO satellites provides the most economical approach to conform to Range Safety guidelines’.

- » **ER To-Date Experiences with TDRSS and Potential Future Uses (Chris Bocchino)**

‘It is clear that, with the possibility of ELV’s employing both TDRSS Forward (ground-to- spacecraft) links for the transmission of Command Destruct messages, and TDRSS Return (spacecraft-to-ground) links for reception of both Range User and Range Safety telemetry data, that this system has great potential to be the cornerstone of a space-based ER architecture.’



CURRENT STATUS

- Most Recent Events (cont'd)
 - 35th Space Congress (Whitepapers Presented) (cont'd)
 - » **TDRSS Experiences in the Atlas Centaur Program (J.P. Stroud)**
 'Significant savings per mission. Typically TDRSS costs are one-fifth the costs of ARIA.' 'No data has been lost for the eleven flights Atlas has elected to fly using TDRSS. The system has a spotless record. TDRSS is a successful step forward in controlling costs and provides quality real-time telemetry data.'
 - **Space Based Range Safety System Concept (Research Triangle Institute)**
 'Efforts should be initiated to further evaluate feasibility of this concept and a team established to refine requirements and develop a plan for demonstrating the proof of concept. NASA/GSFC implies in their 'Draft' they are willing to pursue meeting the Range Safety Requirements and to further define their estimates of feasibility. This opportunity is now and delaying evaluating this concept could allow things to be put in concrete that could be costly and possibly avoided'
 - Newly Formed GSFC Team of Experts: Meeting Conducted Friday, 29 May
 - » GSFC Technology-Based Group to Further Investigate Technical Details

✧ Space-Based Platform Requirements Analysis	✧ Operational Scenarios
✧ CLASS/CAGE Analyses	✧ Loading Analyses
✧ LV Transceiver Specs	✧ Proof of Concept Activities



CURRENT STATUS

- Most Recent Developments
 - The “Magic Box” - LV Equipment with TDRSS Compatible Components and GPS in one box.
 - Telecon with USPACECOM, ER, WR, Florida Spaceport - very strong support to pursue Proof of Concept Test Program for the “Magic Box”
 - ER strongly suggested the desire for GSFC to be Lead Entity for the “Magic Box” Proof of Concept Test Program - DECISION POINT
 - » ER Views GSFC as a Non-Bias Facilitator
 - » ER Specifically Stated They Want Cincinnati Electronics to Develop Breadboard articles (Trusted in Range Community; Already Involved in GPS Range Safety Activities)
 - » ER Specifically Stated They Have the Political Backing and Financial Backing - Looking for a “Vehicle” through GSFC



POINTS OF CONTACT

- Open Communications with Various Organizations
 - Our continuous interface with All Entities has Resulted in an Integrated DOD/NASA Approach to Range Safety
 - » NASA GSFC Management
 - » Range Commanders Council/Range Safety Group
 - » Michael Campbell/45SW Eastern Range (ER) - strong advocates
 - » David Villalpando/Aerospace Corporation (Western Range - WR)
 - » Lt. Commander Al Coxe/US Space Command
 - » Peter Patty/Spaceport Florida
 - » Robert Pickett/ACTA (space-based requirements)
 - » Charles Morris & Robert Baker/RSA II Systems Engineering/ LMCO WDL (Study of Several Space-Based Platforms)
 - » Hal Theiss/Networks Inc. & William Lampe/Cincinnati Electronics
 - » Jack Parks & Lloyd Parker/Research Triangle Institute (RTI)



WHERE TO FROM HERE

- Baseline the SN Support for Range Safety Concept and Feasibility Study with GSFC Team Input. Update Whitepaper accordingly.
- Work with ER to Prepare Presentation for “Road Show” of the Concept
- Decision Point for NASA GSFC Management Concerning the Proposed “Magic Box” Proof of Concept Test Program
 - Lead the Team (GSFC, ER, WR, USSPACECOM)
 - Provide Services
 - Support Proof of Concept



CONCLUSION

- Small Team of Gov't Agencies/Contractors Involved to Maintain Control
- Overwhelming Support for a Space-Based Platform to provided Range Safety Service, TDRSS Focal Point
 - Members of the Range Community (Eastern Range, US Space Command)
 - Political Space Entities (Spaceport Florida)
 - Industry (LV Equipment Vendors)
- The Time is NOW!



BACKUP MATERIAL

(CONCEPTUAL COVERAGE COMPARISON)

